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Eastern State Penitentiary: A Digital Restoration

Nicholas Gregory Golden

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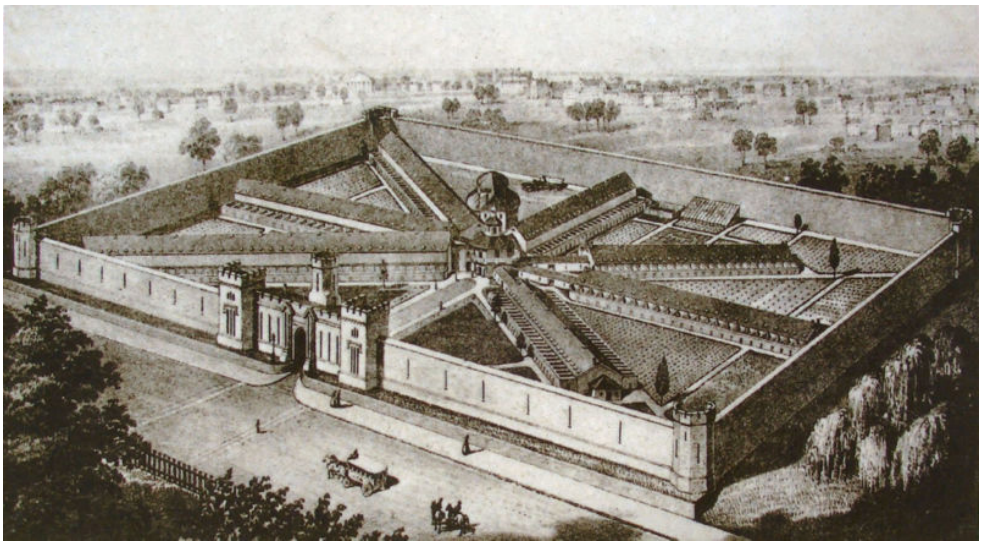

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of:
Master of Fine Arts in Visual Communication Design

School of Design
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Abstract

A model of prison architecture which has been replicated in modern prisons and schools throughout the world, Eastern State Penitentiary was built as the first prison to induce reformation upon its inmates. While kept in solitary confinement inside of generously proportioned cells with barrel vaulted ceilings lit by skylights, inmates were thought to see the light of God and be penitent of their crimes. Today, the interior of the structure is kept in ruin without funding to restore a major cell-block to its former prestige. The cells of the prison today have become dilapidated since the prison closed in 1970 and do not resemble the design of 1829. This project will utilize the immersive qualities of real-time computer graphics to preserve the heritage of Eastern State Penitentiary and provide an interactive lens through which to view the memories of the past.

Keywords

Unreal Engine, Real-time, Architecture, Restoration, Historic Preservation.

Dedication

This thesis is dedicated to my father, Gregory Charles Golden, who was beautiful and kind. Thank you for giving me the life and opportunites you never had.

Problem Statement

Eastern State Penitentiary as an institution was designed by John Haviland to inflict suffering upon the mind and impress dread and terror upon its inhabitants as a deterrent to the commission of crime. A prison administrator once described the Penitentiary as "a monastery inhabited by men who do not choose to be monks." [1]

Charles Dickens visited Eastern State Penitentiary in 1842 and logged his thoughts in his travel journal, American Notes for General Circulation. The chapter *Philadelphia and its Solitary Prison* reads, "In its intention I am well convinced that it is kind, humane, and meant for reformation; but I am persuaded that those who designed this system of Prison Discipline, and those benevolent gentleman who carry it into execution, do not know what it is that they are doing....I hold this slow and daily tampering with the mysteries of the brain to be immeasurably worse than any torture of the body; and because its ghastly signs and tokens are not so palpable to the eye,... and it extorts few cries that human ears can hear; therefore I the more denounce it, as a secret punishment in which slumbering humanity is not roused up to stay." [2]

Functionally, the exterior of Eastern State was designed to evoke fear. The structure, which loomed on a hill outside of the city of Philadelphia, cast an ominous gloom on all who gazed upon it. It was thought by its designers that by making the building visible to the townsfolk it would instill enough dread to discourage the commitment of crime. In contrast, the interior of the building was designed to reform the mind of an inmate. By keeping prisoners isolated in chapel-like cells, it was thought that the inner light of their souls would emerge, leading them to discover penitence.

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1 Norman Johnston, Kenneth Finkel, and Jeffrey A. Cohen, *Eastern State Penitentiary Crucible of Good Intentions*, (Philadelphia: Philadelphia Museum of Art, 2010), 47

2 Eastern State Penitentiary, "General Overview." Accessed March 20, 2014. http://www.eastern-state.org/learn/research-library/history.

Problem Statement

The punishment of crime through isolation lead to a host of horrors including the deterioration of the health of many inmates. The pressures and stresses of living through a sentence at Eastern State are incalculable. We have no way to document quantitatively the amount of fear or anxiety an inmate experienced, or a verifiable way to differentiate the emotional levels of their day-to-day lives. Historians typically distance themselves from events that they are trying to understand in order to let the emotions die down. It allows one to have a sensible and logical perspective when analyzing events of the past even though the events of the past more often than not are far from sensible or logical. Alexander Herzen wrote that history is the autobiography of a madman, and you may have to assume the role of a madman in order to understand it.

This thesis project will differentiate itself from other digital restorations by visually communicating the intangibles of history. The areas of human emotion that can't be plotted on a graph or measured with carbon dating are integral to understanding the sociological dynamics of the past and can be invoked through art and design. Eastern State, the most significant building project of its time, is kept in preserve ruin and is an important facet of history that is in danger of evaporating from public discourse. I intend to preserve the both memory and intentions of the building and bring them to the community in a new and exciting way utilizing real-time physically based rendering in the Unreal Engine.

The memory of these inmates, as well as the memory of the environment as it stood nearly 200 years ago, will be restored and preserved in digital format that may be accessed by anyone at any time. The challenge of providing academic validation to the historicity of its contents will be done through the omission of hypothetical information and will instead accurately restore the structure based on verifiable documentation to the condition in which it existed circa 1840. In doing so, I aim to humanize the history of Eastern State Penitentiary in a way that contributes to a visitor's experience by paying homage to the functional intentions of the structure.

Context

The term “real-time” refers to the ability to navigate around a virtual space through a physical interface such as a keyboard and mouse, touch screen, or modern video-game controller. The image on display updates dynamically, providing feedback based on input received from the interface. The result of this is an interactive experience that allows one to explore an environment freely, sidestepping the limitations of traditional mediums and providing each user their own incredibly unique and immersive experience.

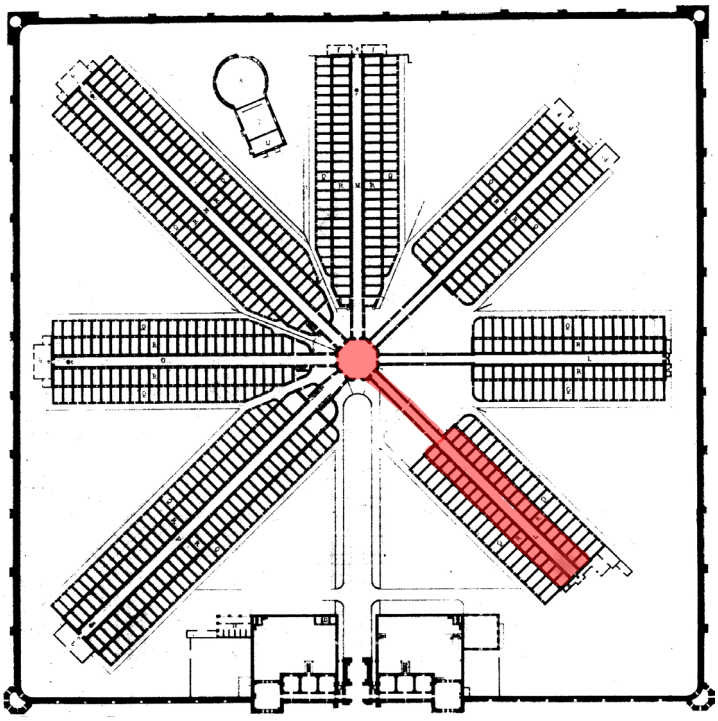
Currently, the reconstruction of historic structures through the use of three-dimensional models is common through the use of photogrammetry and detailed architectural drawings, however there is a void in providing an interactive experience that transcends the typical static representation of history often seen in museums and textbooks. There is an unexplored opportunity to provide viewers a lens through which they can virtually experience an environment of the past through physically based real–time rendering with verifiable historicity and cultural significance.

Historic preservation provides a lens through history, championing and protecting the places that tell the stories of the past. Additionally, the field of preservation provides an opportunity for the immersive quality of real–time rendering to document and illustrate significant pieces of cultural heritage. One such structure, Eastern State Penitentiary, is one of the only early prison structures of international importance still standing today. Currently it is kept in preserved ruin and no significant renovations have been made since the prison was closed in 1971. With current technology, there is a way to digitally restore the structure without sacrificing any of the historic fabric of the structure in a way that contributes to its historic character and national heritage in a way that traditional architectural drawings cannot.

Methodological Design

Rendering is the process of producing a 2D image from the description of a 3D scene. Physically based techniques attempt to simulate reality; that is to say that they use principles of physics to model the interaction of light and matter. In physically based rendering, realism is usually the primary goal. This approach is in contrast to interactive rendering, which sacrifices realism for high performance and low latency, or nonphotorealistic rendering, which strives for artistic freedom and expressiveness. Most physically based rendering systems are based on the ray-tracing algorithm. Ray tracing is actually a very simple algorithm; it is based on following the path of a ray of light through a scene as it interacts with and bounces off objects in an environment. Although there are many ways to write a ray tracer, all such systems simulate at least the following objects and phenomena: Cameras, ray-object intersections, light distribution, visibility, surface scattering, recursive ray tracing, and ray propagation

The highlighted area will follow a modular approach to its reconstruction.



Methodological Design

Asset Compilation

Prison Cell- 12’ x 10’ x 8’

Modular -

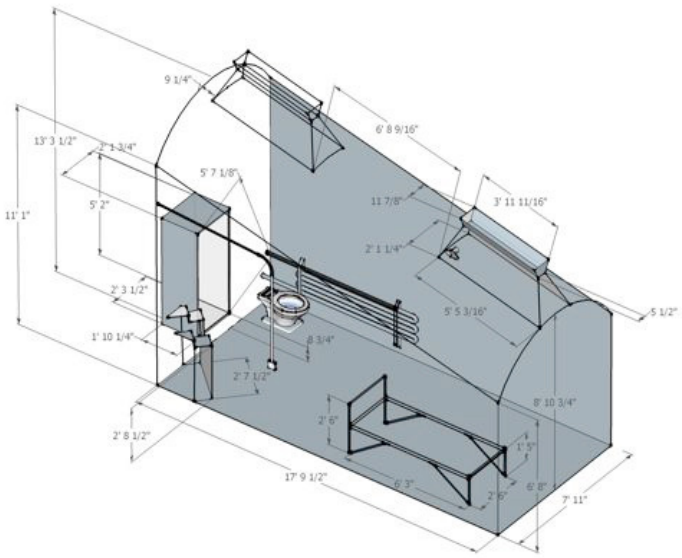
Wall (White Plaster with Green Trim), Wall-Meets-Floor Trim (White Plaster), Barrel Vault Ceiling (Model Half with Skylight Integrated)(White Plaster), Floor Tile (Exposed Wood Planks)

Repeating Architectural Elements-

Radiator (White Painted Metal), Toilet (White Painted Metal), Door(Exposed Wood), Door Lock(Exposed Metal/Rust), Door Chain(Exposed Metal/Rust), Door Hinges (Exposed Metal Rust)

Nonrepeating Architectural Elements-

Bed ((Exposed Metal), Chairs (Exposed Wood), Clock (Exposed Wood)



Methodological Design

Asset Compilation

Cell Block - 10’ wide by 250’ long by variable height –

Modular –

Wall (White Plaster with Green Trim), Wall-Meets-Floor Trim (White Plaster), Barrel Vault Ceiling (with Rectilinear Skylight Integrated)(White Plaster), Floor Tile (Exposed Concrete)

Repeating Architectural Elements –

Piping and fluid system (White Painted Metal), Door Assembly (Green Painted Wood), Door Hinges (Exposed Metal), Door Locks and Chains (Exposed Metal)

Nonrepeating Architectural Elements –

Dirt, debris and particulates in the air, sweat and condensation on the walls from moisture, various imperfections, leaks and cracks, rays of light cast down from skylights

Design Ideation

"Good design is to produce, by means of sufferings principally acting on the mind and accompanied with moral and religious instruction, a disposition to virtuous conduct, the only sure preventative of crime; and where this beneficial effect does not follow, to impress so great a dread and terror, as to deter the offender from the commission of crime in the state where the system of solitary confinement exists." [3]

**Images obtained during my guided tour of Eastern State.*

3 Norman Johnston, Kenneth Finkel, and Jeffrey A. Cohen,Eastern State Penitentiary Crucible of Good Intentions, (Philadelphia: Philadelphia Museum of Art, 2010), 32

Design Ideation

While Eastern State's interior was intended to resemble a church to invoke mental salvation, it was infamous for problems with its heating and ventilation. This meant that cells were unhealthily damp and the temperatures of the cells would vary between extremes. The plumbing system, designed to be flushed twice a week, often meant that waste was left in the pipes for days forcing prisoners to breath polluted air. Penitentiary administrators raised questions of contagion, questioning whether or not the combination of dampness, lack of fresh air, and secretions from the toilets caused rates of illness to be higher than those of other prisons. I intend to visually represent the living conditions of inmates at Eastern through volumetric lighting, refracted lighting, localized reflections, high contrast between light and dark areas, blend shaders, and blend masks.

**Images obtained during my guided tour of Eastern State.*

Design Ideation

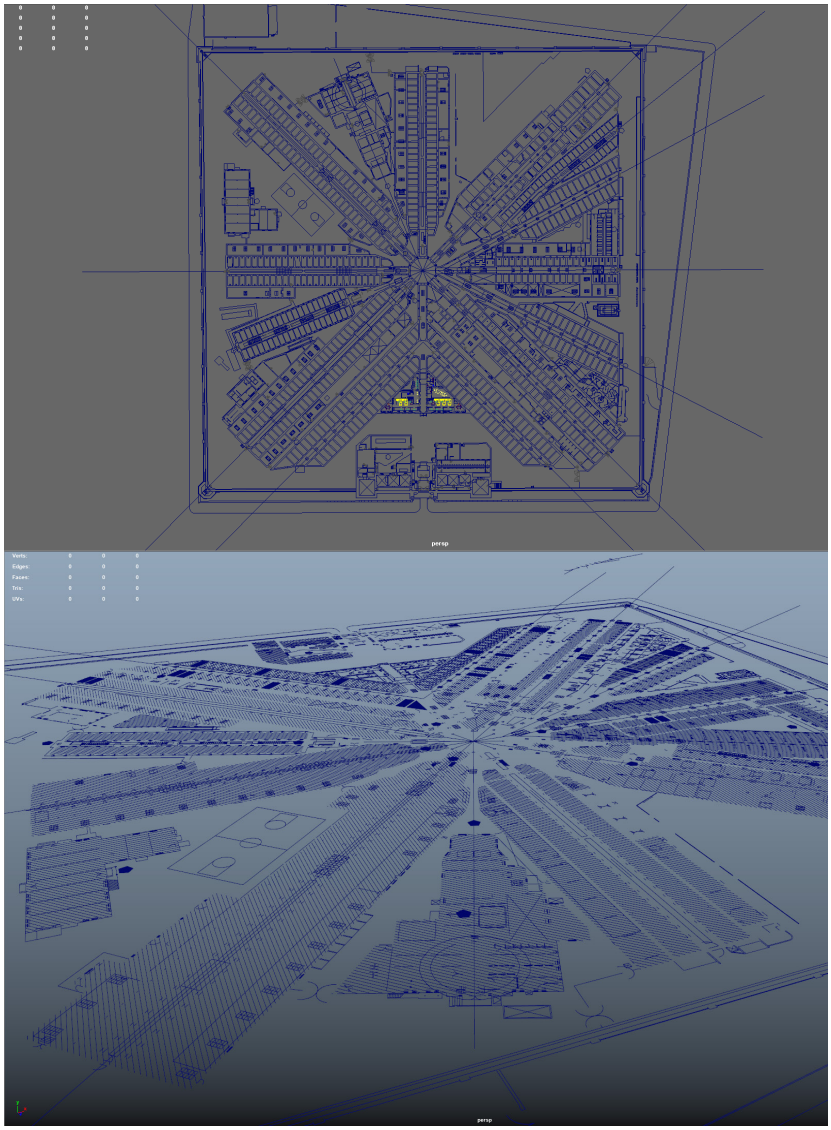
The floorplan of Eastern State Penitentiary stems from the Enlightment era thinking of philosophe Jeremy Betham, who conceptualized a facility where a single administrator could act as an Angel who watched over those who strayed from the path of God. [4] When Eastern State opened in 1829, it was the most expensive and ambitious American building constructed. Bentham's vision was realized through a central rotunda, a surveillance watcher that allowed any cellblock to be observed via this innermost location. Since the construction of Eastern State, the hub-and-spoke floorplan has been replicated by hundreds of buildings throughout the world.

In addition to visually illustrating the well–documented living conditions of the cells for the prisoners and the church–like treatment of radial cellblocks illuminated by skylights imbedded into barrel vaulted ceilings, I intend for my project to include the central rotunda as an explorable area to experience this powerful vantage point.

4 Bentham, Jeremy The Panopticon Writings. Ed. Miran Bozovic (London: Verso, 1995). p. 29-95

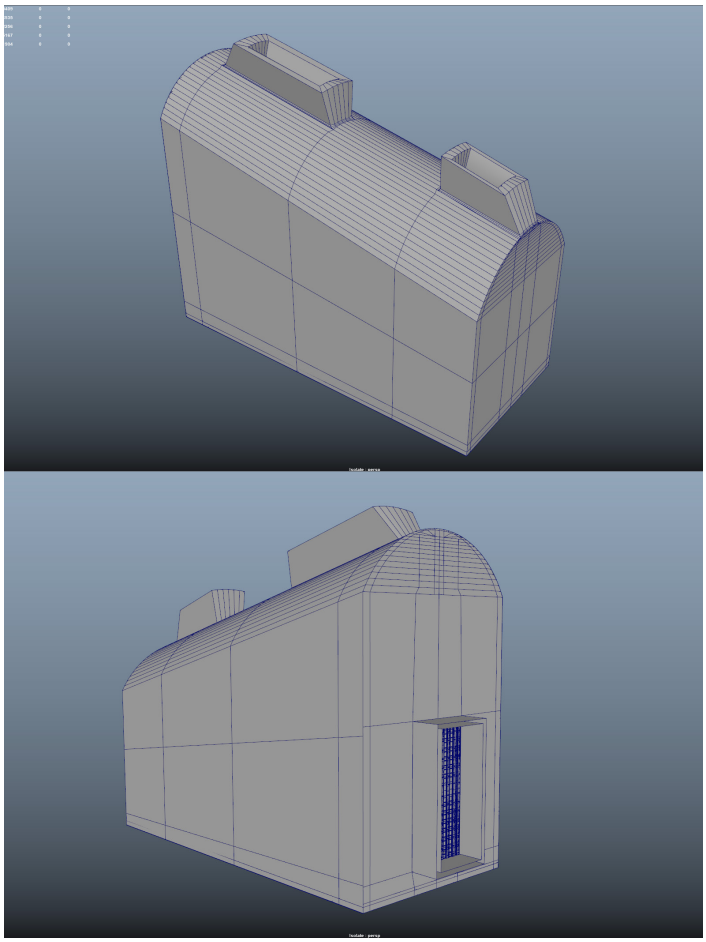
Process

To begin the project, I reached out to Sean Kelley, then the Senior Vice President and Director of Public Programming at Eastern State Penitentiary to request access to any CAD drawings of the site that they may have had available. Sean was able to provide 2D elevation drawings of the floor and ceilings from which I could base the overall dimensions of my 3D model.



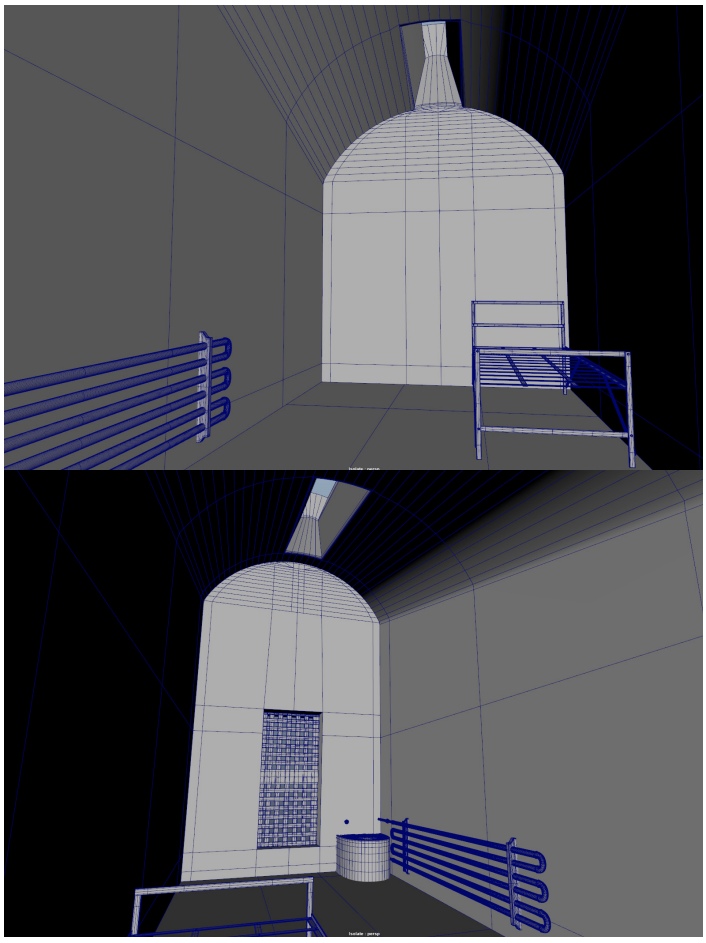
Process

I began by modeling the cell to its exact specifications. It was important to be as accurate as possible, though these models are done with the help of dimensions provided by Eastern State they are not laser accurate. It is important to the historicity of the structure, to model as authentically as possible, however it is just as important to simulate accurate lighting to model in real-world scale. This is so that the photon calculations of the game engine can correctly propagate. If the models were not to scale, the lighting calculations would look fake, like a doll house, which is not within the design methodology of this project.



Process

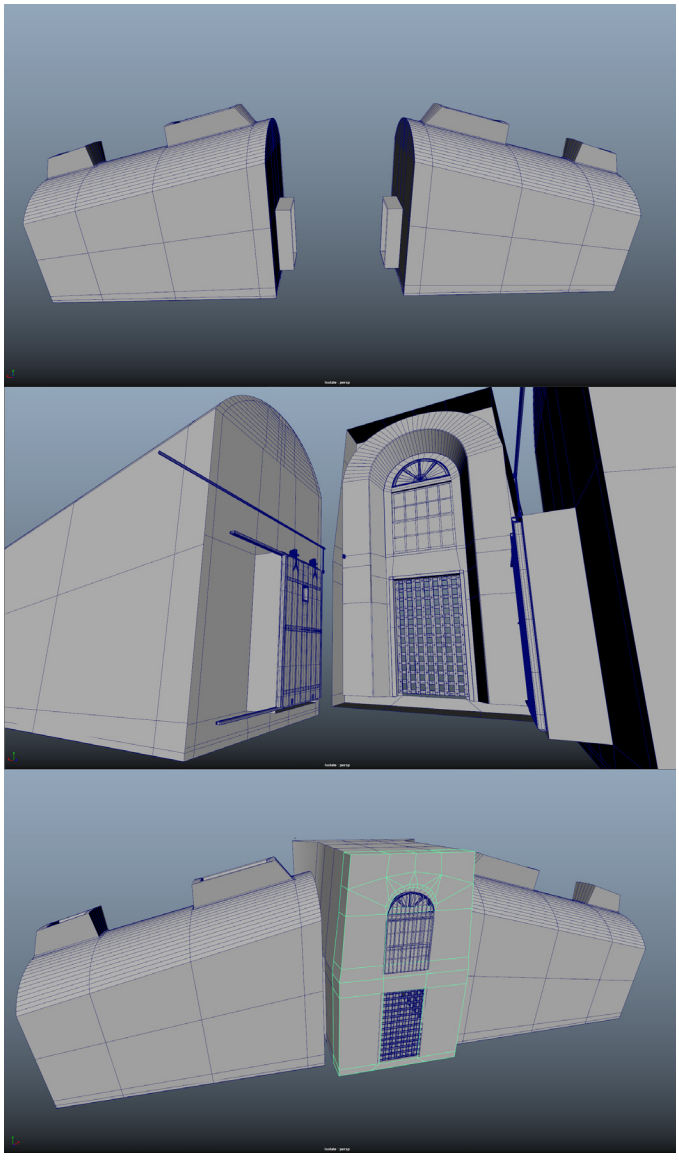
For the purposes of the cell modules, nonrepeating architectural elements were included as these would later be duplicated per the best practices outlined by Joel Burgess in his presentation "Skyrim's Modular Approach to Level Design." [5]



5 Joel Burgess, . Gamasutra: The Art & Business of Making Games, "Skyrim's Modular Approach to Level Design." Last modified 05 01, 2013. Accessed January 25, 2014. http://www.gamasutra.com/blogs/JoelBurgess/20130501/191514/Skyrims_Modular_Approach_to_Level_Design.php

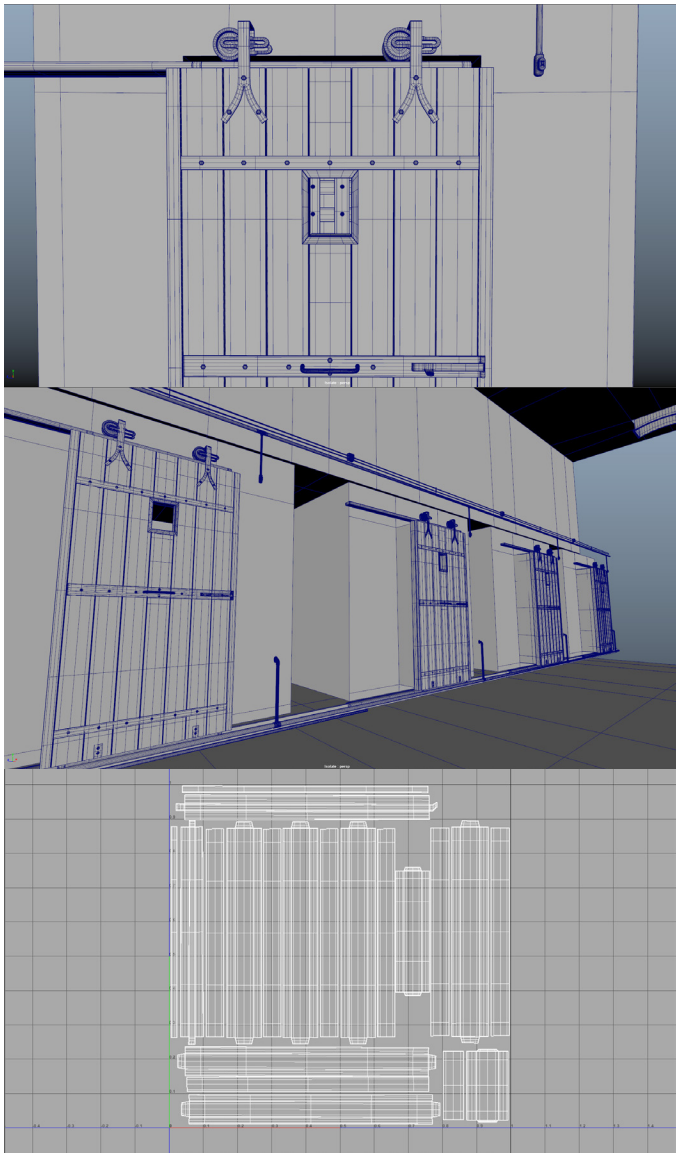
Development

Where possible, assets were grouped based on where they would repeat and duplicated into the scene based on distances measured from the elevation drawings. Where information was not available in the elevation drawings, reference photography was used per my visit to the Penitentiary.



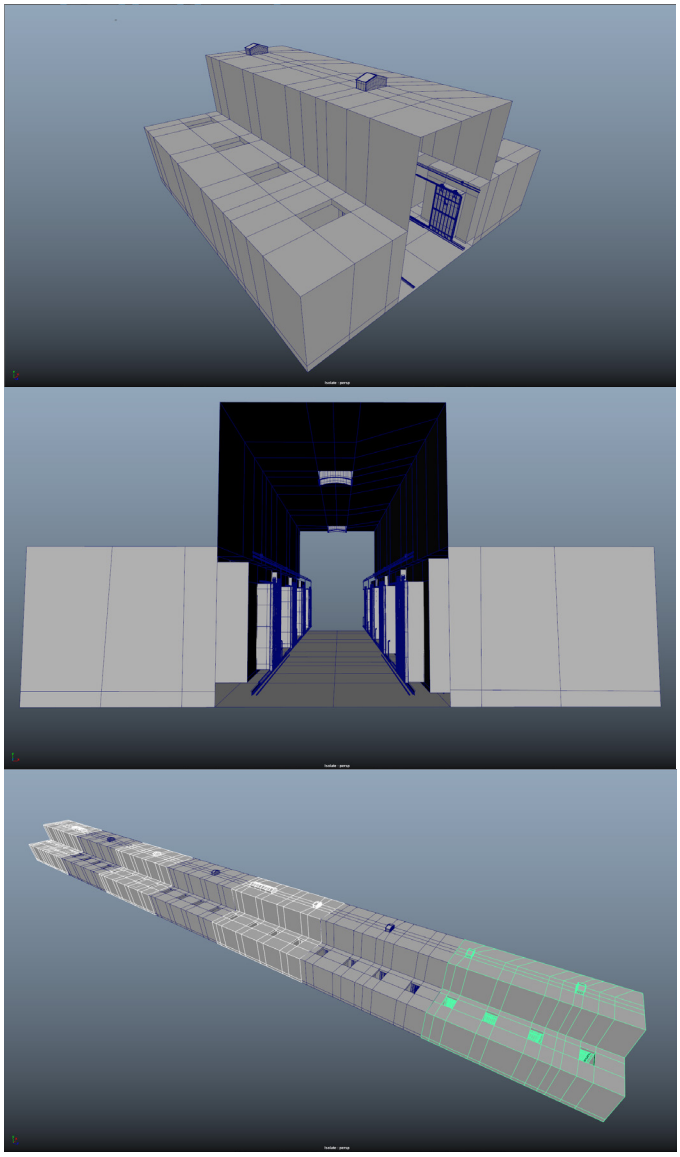
Development

As much detail as possible, within GPU memory limits (less than 12GB) was included in the creation of the assets. They were also UV'd to be compatible with Unreal Engine's Static Lightmass photon calculations, which requires that all UV's be packed within 0-1 space on a grid.



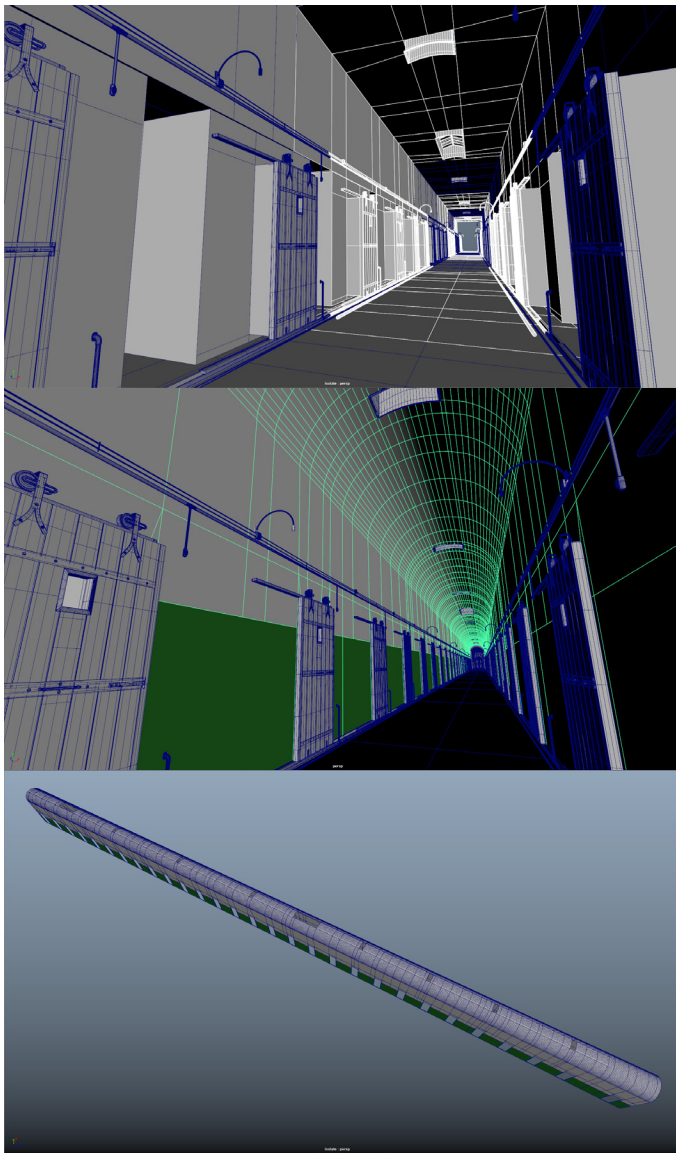
Development

All repeatable architectural elements were packed into a prefabricated module that could be duplicated to match the repeating modules of the Penitentiary. Non repeating elements in these areas, the skylights, were later matched per the provided elevation drawing.



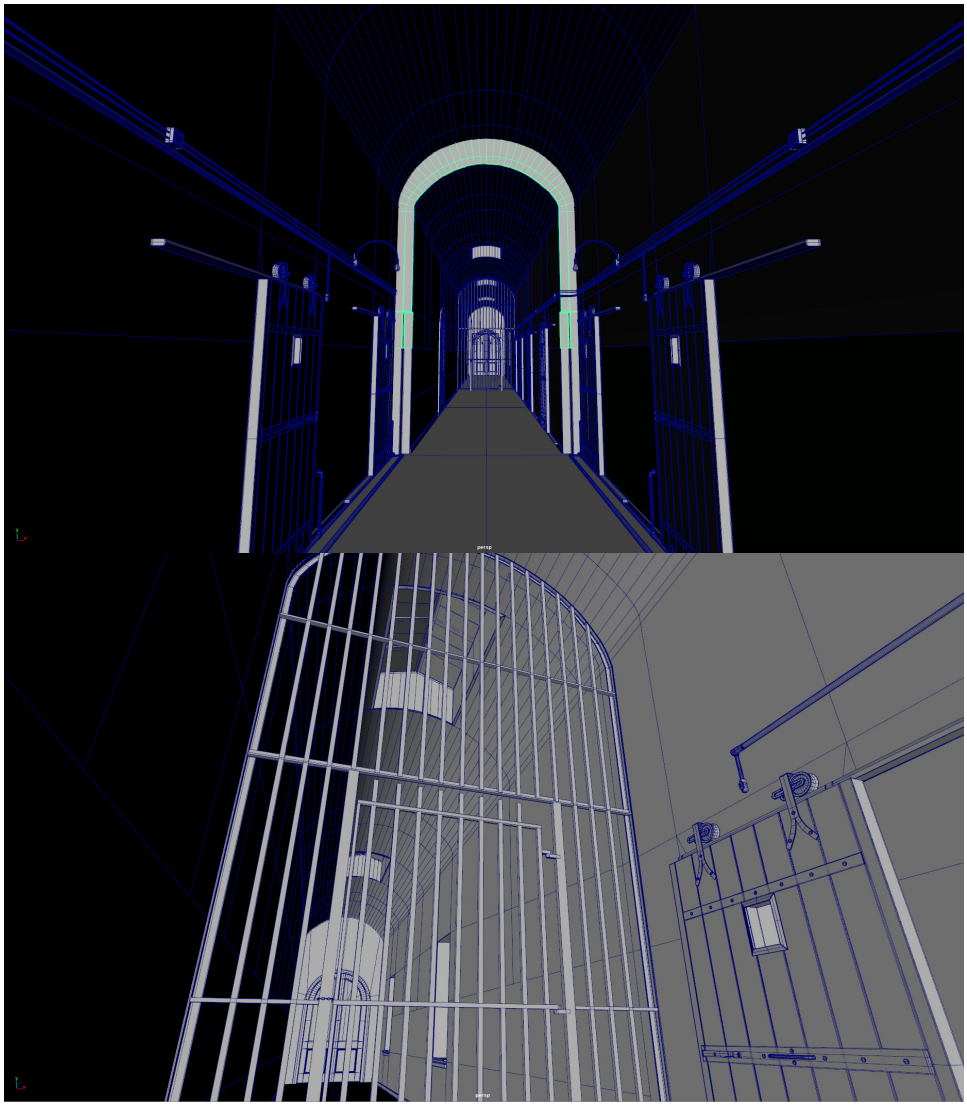
Development

The walls and floors were added, which had to be modeled, built, and UV'd seperately to avoid any seams in textures or lightmaps. Without carefully considering these, seams would appear in the later renders wherever architectural elements repeat.



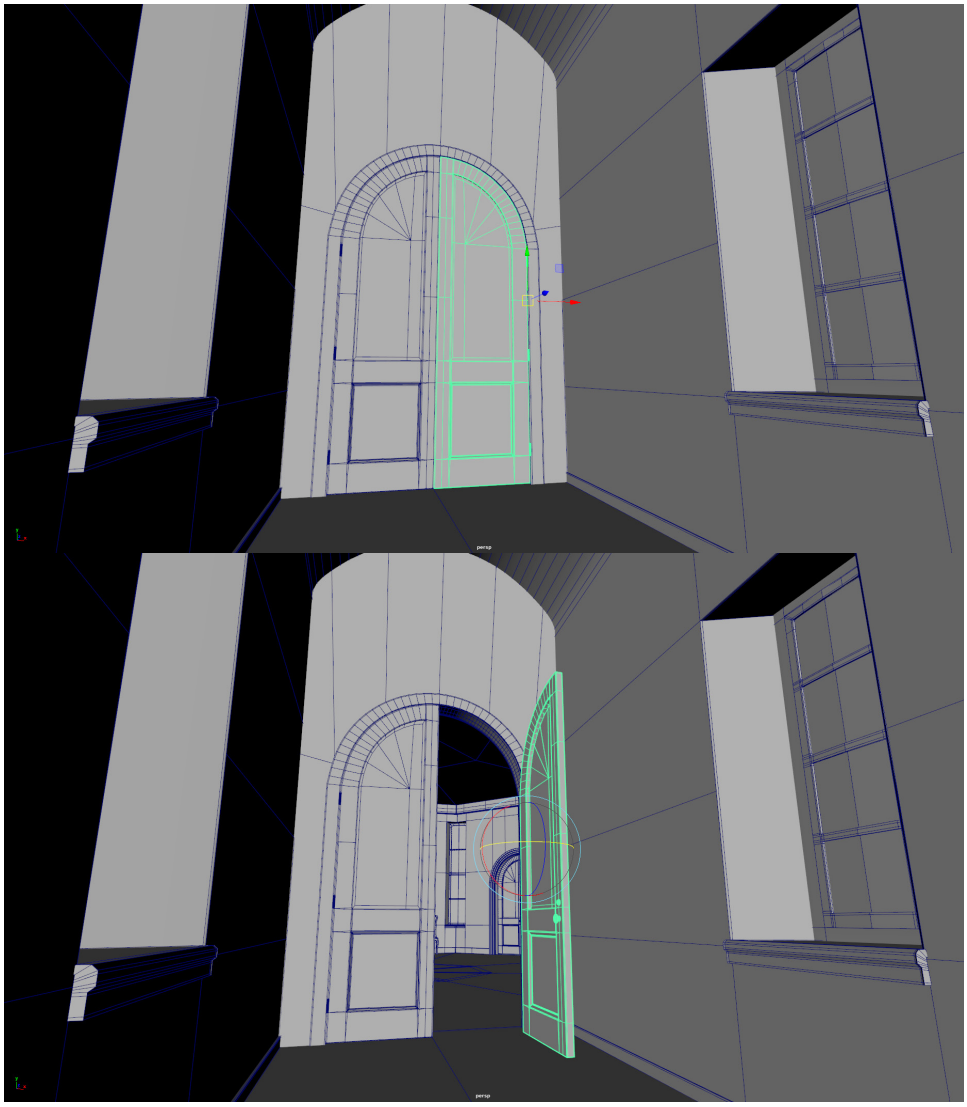
Development

While much of the prison includes repeating architectural elements, there were many areas that had subtle variations that required additional detail and precision. These moments were successfully captured due to my personal visit to the site and the extensive reference captured. Because this is an old building, it does not follow a modular approach as mathematically as a modern building.



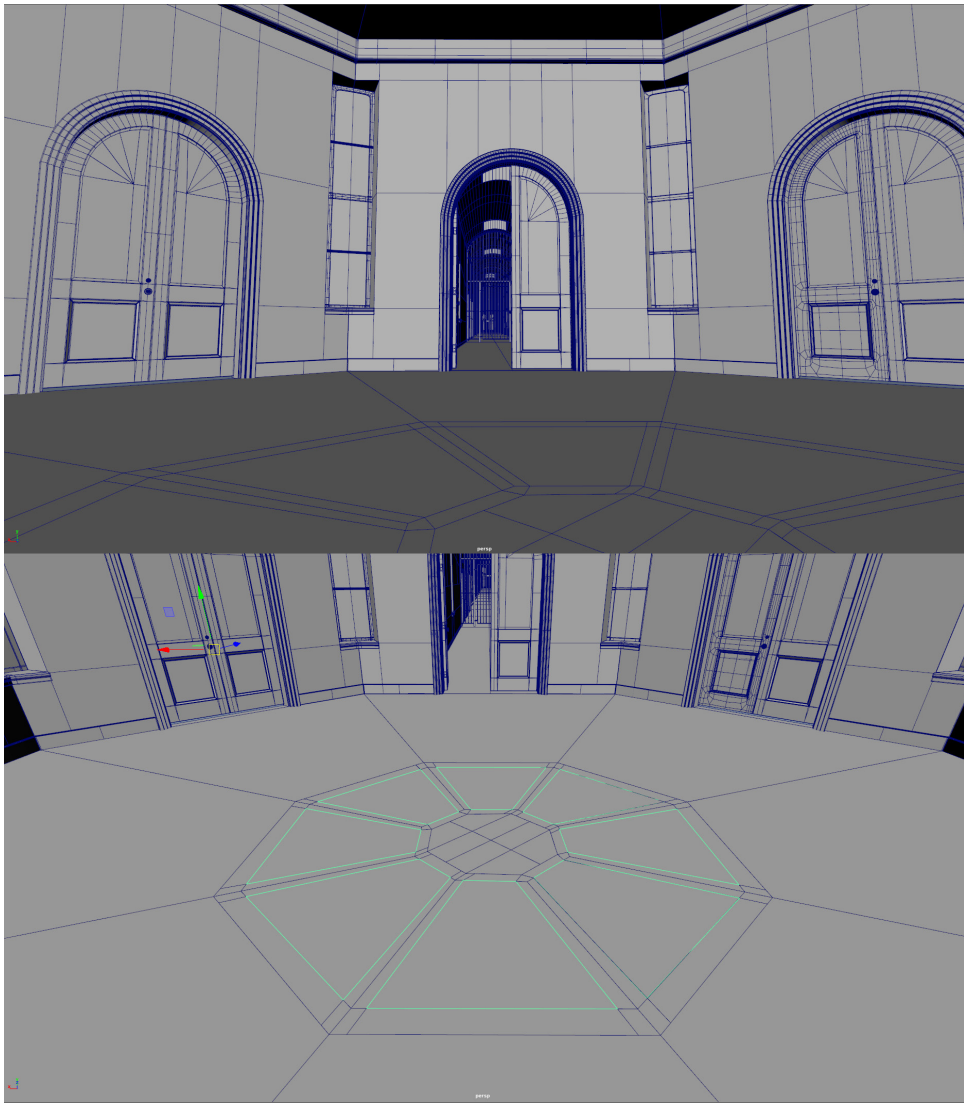
Development

Since this building is being designed for a real-time environment, objects are grouped, merged, and optimized for motion and rigging. While rigging, motion graphics, and interactivity are not within the scope of this particular project, the geometry is still built in a way that it would support this effort at a later time.



Development

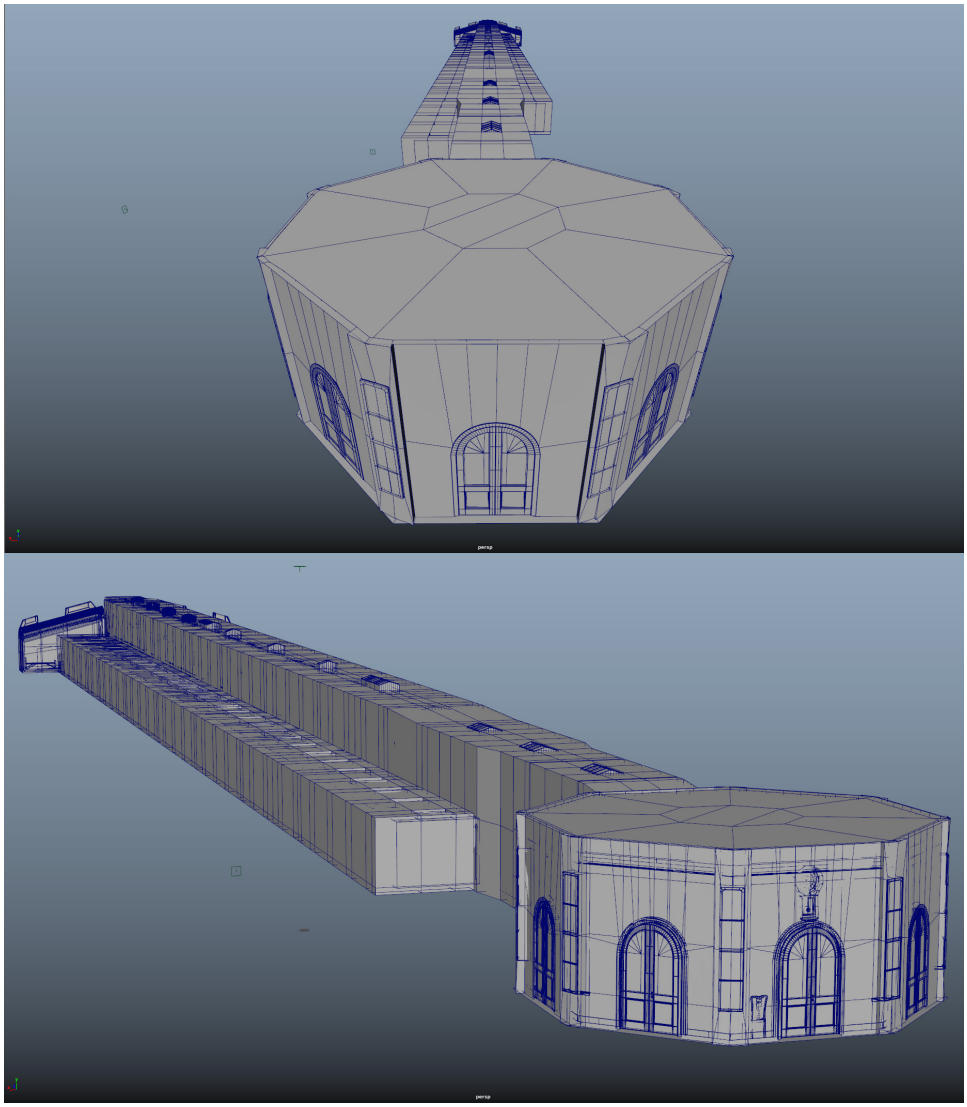
The central rotunda, the oculus of the building, was completed though the fully constructed hallway was not duplicated around the rotunda due to memory constraints and the scope of the project. Future use of geometry caching, instancing, or increased hardware memory limitations will allow for the full-scale creation of the Penitentiary at the level of fidelity that it has been modeled for this project. Lastly, objects are grouped and tagged per their material ID - example below shows the parquet flooring.



Development

The full scale of the model, shown with both an 18mm lens and 85mm lens.

Note the exterior blocking geometry includes exterior faces for the structure. This is so that photons from the exterior light right do not bleed into areas of the geometry where they are not intended to be seen.



Development

Eastern State Penitentiary as an institution was designed to impress dread and terror upon its inhabitants as a deterrent to the commision of crime while also fostering an intimate relationship with God. The use of color grading in the second image introduces blues into the shadows and warm tones into the light areas like a chapel while simultaneously desaturating the overall image, as the penetintary inevitably appeared stark and ghastly to its inhabitants. The effect is subtle, but pushes contrast and reduces warmth.

Development

Added ambient occlusion creates more contact shadows between objects, giving them greater contrast. This enhanced contrasts adds to the weight of the elements, making the doors designed to punish social deviants and promote obedient God-fearing behavior appear heavy and unmovable.

Development

Eastern State Penitentiary was designed to reshape the minds of its inmates, rather than punish the body of one. While being kept in solitary confinement, the tampering with the mysteries of the brain were often worse than any physical torture. The effect of chromatic aberration, demonstrated in the image below, captures optically the wandering mind by simulating an inability to for a camera (or eye) to focus, blurring wavelengths of color.

Development

Before the introduction of prisons, colonists equated crime with sin. Colonists believed sinful impulses were an unfortunate but inevitable consequence of mans fallen nature and that crime might
be deterred through fear. The addition of vingette to the bottom images adds contrast to the scene, creating more tension and helps to create a feeling of tunnel vision, leaving the viewers mind to wander and fill in the missing pieces.

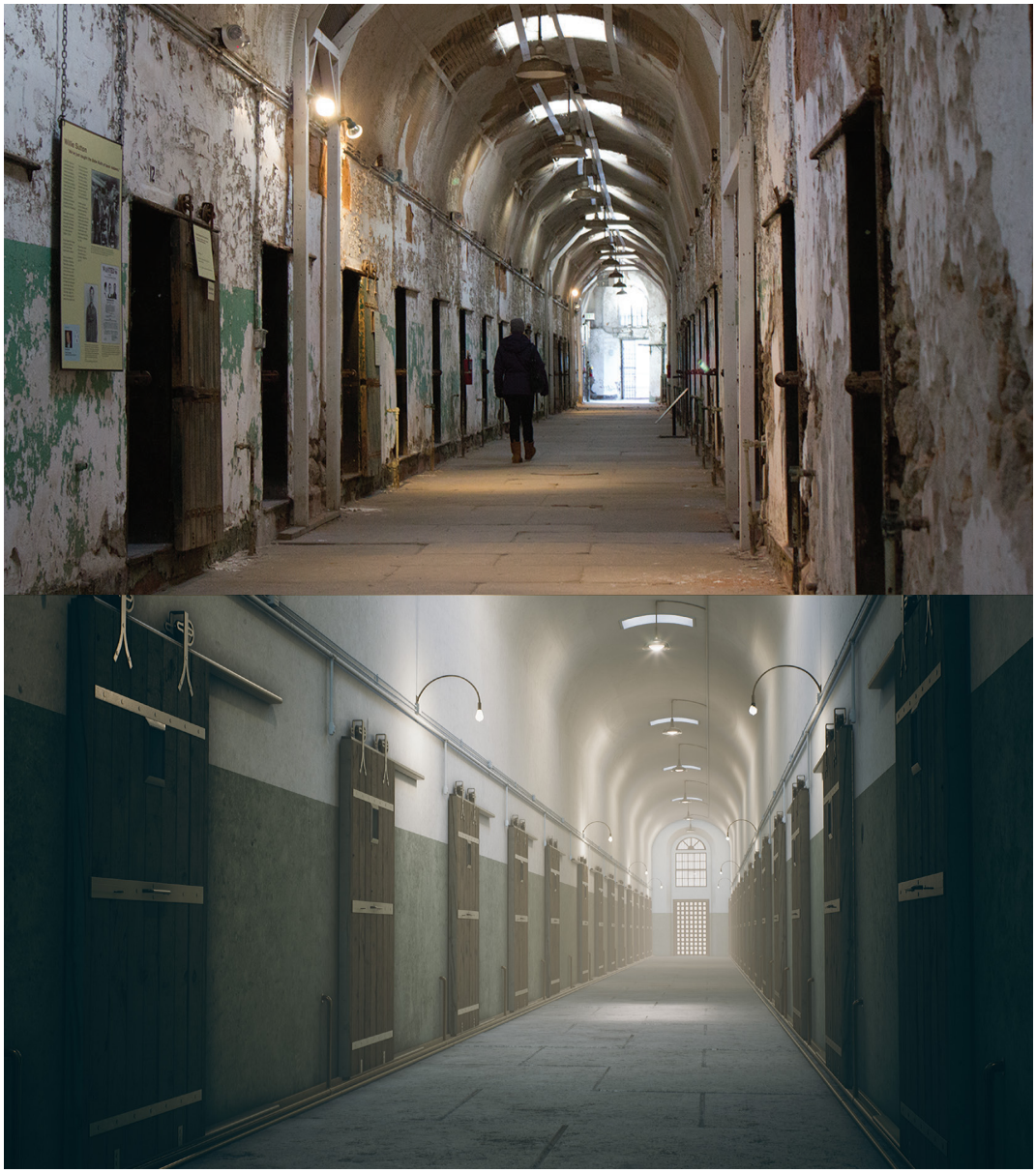
Development

Development

It was believed that by keeping prisoners isolated in chapel-like cells the inner light of their souls would emerge, leading them to discover penitence. Demonstrated in the image below, volumetric lighting was used to simulate the church-like lighting of the building while balanced against the horrific experiences of the inmates through desaturated color grading, vignette, chromatic aberration, and heavy contrasting shadows with ambient occlusion.

Results

Approximated camera comparisons; captured reference on top, rendered output on bottom.



Results

Approximated camera comparisons; captured reference on top, rendered output on bottom.

Results

Approximated camera comparisons; captured reference on top, rendered output on bottom.

Results

Results

Results

Results

Conclusion

The immersive qualities of real-time computer graphics are predominately effective in storytelling. Video games utilizing next-generation technologies have tremendous appeal because they allow players to embody their own fantasies and conjure unique events in virtual worlds with little consequence. The sensation of power imbued into a player of the Grand Theft Auto franchise can be intoxicating as one acts out a narrative of luxury and violence through the eclectic portrayal of digital gangsters. The influence of these virtual experiences can be so impactful that some critics claim that people, especially children, may struggle to differentiate fantasy from reality. This underscores the transformational power of interactive media.

In congruence, the capabilities of this captivating medium are in constant development. Improvements to visual fidelity are based in natural phenomena and the algorithmic approximations used to simulated natural environments are designed to be physically accurate. It is because of recent advancements in physically based rendering that virtual environments have the potential to extend beyond the realm of storytelling in video games and make impactful contributions to the fields of architecture, design, art history and beyond. As real-time technologies continue to progress, raytracing could be added to this project to enhance its realism and fidelity. Separately, it could be optimized for Virtual Reality, and installed at a dedication section of the penitentiary.

Currently, the reconstruction of historic structures through the use of three-dimensional models is common through the use of photogrammetry and detailed architectural drawings, however there is a void in providing an interactive experience that transcends the typical static representation of history often seen in museums and textbooks. There has been an unexplored opportunity to provide viewers a lens through which they can virtually experience an environment of the past through physically based real–time rendering with verifiable historicity and cultural significance.

Conclusion

The goal of this project was to provide a new lens through which to view history, championing and protecting the places that tell the stories of the past. Additionally, the field of preservation provides an opportunity for the immersive quality of real–time rendering to document and illustrate significant pieces of cultural heritage. Eastern State Penitentiary is kept in preserved ruin and no significant renovations have been made since the prison was closed in 1971. This project has digitally restored the structure in a way that that contributes to its historic character and national heritage using techniques that traditional architectural drawings cannot and can be used in future use-cases to enhance or supplement current tours, site visitation, or enhance the promotion of cultural heritage awareness.

Survey of Literature

1. **Johnston, Norman, Kenneth Finkel, and Jeffrey A. Cohen. Eastern State Penitentiary Crucible of Good Intentions. Philadelphia: Philadelphia Museum of Art, 2010.**

   This book serves as an exploration of the legacy of Eastern State Penitentiary as a functioning prison and comments on its early implementation as well as its overall influence on the methods of treating criminals through corrections facilities. The book argues Eastern State Penitentiary must be considered the most influential prison ever built as it served as direct inspiration for over three hundred prisons worldwide in addition to being the most significant ideological and expensive attempt at prison reform in its time.

2. **Dolan, Francis X. Images of America Eastern State Penitentiary. Charleston, South Carolina: Arcadia Publishing, 2007.**

   A collection of photographs from the sites archives donated by men and women who experienced Eastern State Penitentiary first hand. Using archival photographs will be important in keeping the integrity of the restoration accurate and verifiable.

3. **Bassler, Bruce. Architectural Graphic Standards Ninth Edition. New York, NY: John Wiley & Sons, Inc., 2000.**

   A valuable technical resource for anyone in the practice of building design and construction. *Architectural Graphic Standards* specifically addresses architectural requirements for historical research including degree of completeness, deciding what will best explain and illustrate the various features of the structure, level of detail, level of accuracy, comparison measurements, and standards for documentation to be included in a rehabilitation or restoration project.

Survey of Literature

4. **Aydin, Caglar, "The Potentiarl Of Virtual Heritage Reconstruction In Lost Ansonborough" (2012). All Theses. Paper 1353.**

   A graduate thesis by a former student at Clemson University which exhibits virtual reconstruction in Charleston, South Carolina. The author provides current observations regarding issues of conservation in virtual heritage. He calls for a structured 3D archive of cultural heritage models which are peer-reviewed and submitted to a central archive. As of now, all virtual heritage models are ephemeral and long-term consideration must be taken into account if this method of preservation is going to supplant traditional methods of restoration.

5. **(Guided Tour), Eastern State Penitentiary 01 14, 2014.**

   I made a personal trip to Eastern State Penitentiary where I took a guided tour. It was important to experience the environment first hand as it provided a clear and coherent understanding of the scale of the building and its complex spacial relationships. I brought along a camera to document design elements that I knew would be incorporated into my project. Particular attention was given to individual prison cells, original cell blocks, and the exterior street-view of the structure.

6. **Eastern State Penitentiary, "General Overview." Accessed March 20, 2014. http://www.easternstate.org/learn/research-library/history.**

   The official website of Eastern State Penitentiary provides general documentation, history, and exploration through which to asses the structure. Similarly, contact information, mission statements and press releases are accessable through the website. I have also found measured drawings of the prison from this website through which I will validate the dimensions of my models.

Survey of Literature

7. **The Colonial Williamsburg Foundation, "Virtual Williamsburg." Last modified 2013. Accessed March 20, 2014. http://research.history.org/vw1776/.**

   Colonial Williamsburg has launched an educational project utilizing the Unity 3D game engine to enable users to explore sites, historical residents, and objects found at Colonial Williamsburg. The project intends to develop an interactive virtual environment for visitors to explore and understand the Virginia of 1776. Their model intends to launch first for web before being converted into an onsite application and serves as a model which I can reference for pragmatic implementation and dissemination of my thesis.

8. **Aria Danaparamita, "Coming to Drayton Hall: Historic Preservation in 3D," PreservationNation Blog(blog), July 22, 2013, http://blog.preservationnation.org/2013/07/22/coming-to-drayton-hall-historic-preservation-in-3d/**

   A valuable resource for me. The author writes "This past spring, Trish Smith, Drayton Hall's house manager and preservation technician, became the first 3D visualization fellow at Colonial Williamsburg's Digital History Center. "We have no plans to ever restore it, but with this technology we can digitally restore it to its zenith in the 18th century," Smith says. "I learned how to use software often used to create video games to build photorealistic, interactive models of historic buildings and landscapes," she explains.

   This serves me as a model through which preservationists stage a digital project. I can study their academic and systematic approach to asset development to aid in my conscious omission of hypothetical data.

Survey of Literature

9. **Dr Ritmeyer, . Ritmeyer Archaeological Design, "The Arch of Titus Digital Restoration Project." Last modified June 22, 2012. Accessed March 20, 2014. http://www.ritmeyer.com/2012/06/22/the-arch-of-titus-digital-restoration-project/.**

   Dr. Steven Fine, of the Yeshiva University Center for Israel Studies in New York, has used a Breuckmann GmbH 3D scanner to create a 3D representation of the reliefs on the Arch of Titus to determine whether any traces of paint decoration were preserved. The next phase of the project includes further data collection to create a three-dimensional digital model of the arch in its original depiction, including the painted coloration on its surface. This project is well executed but poorly presented and validates the need for visual designers to showcase the findings of these doctors in a way that adds to cultural heritage and brings a level of visual fidelity to enhance the experience.

10. **Digitale Archäologie, "LINK3D." Last modified 10 1, 2011. Accessed March 20, 2014. http://www.digital-archaeology.com/Start.htm.**

    A European compnany which specializes in 3D visualizations and reconstructions of archeological objects. Their work has been made for TV, film, web, and museum installation. Project exhibitions of theirs show the potential of digital restorations through various professional applications. I have found that digital heritage projects are far more common in Europe than they are in Ameriac.

11. **PreservationDirectory.com, "the online resource for historic preservation, building restoration and cultural resource management in the United States & Canada.." Last modified 2014. Accessed March 20, 2014. http://www.preservationdirectory.com/HistoricalPreservation/Home.aspx.**

    With the goal of fostering the preservation of historic buildings, historic downtowns and neighborhoods, this resource will provide an avenue through which I may reach out to other historic preservation professionals and the general public.

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12. **Szamalek, . "The Witcher 3: Wild Hunt - EXCLUSIVE Interview - Eurogamer." Sept 6, 2013. April 4, 2014. https://www.youtube.com/watch?v=PN0PEnjGNMQ.**

    Interview which describes the way which next–generation video game developers are using historians to both validate and add to their content and products in meaningful ways. This particular example cites the Polish company CD Projeckt RED as they develope the story of The Witcher using Nordic locations and lore to populate this iteration of their game.

13. **Jade Raymond, . "Assassins Creed interview with Jade Raymond." June 12, 2007. April 5, 2014. https://www.youtube.com/watch?v=5aaMPXDXrK4.**

    An online interview with a producer from the Montreal branch of Ubisoft which developed the first installation of the Assassins Creed franchise. She describes how the company used historians to provide reference material, data bases of images, layout drawings of cities, and review and validate their script and art direction for accuracy.

14. **Ben Kuchera, . "Selecting victims in Assassin's Creed 3: These are real people, and this is where and when they died." The Penny Arcade Report, May 5, 12. http://penny-arcade.com/report/article/selecting-victims-in-assassins-creed-3-these-are-real-people-and-this-is-wh (accessed April 6, 2014).**

    Ben Kuchera describes the assassinations of characters presented during the third installation of the Assassins Creed franchise. The game takes place during the American Revolution and Kuchera is quoted as saying, "It's super difficult, this period, because no one famous dies. We have a rule: Everyone dies in this year at the right place. They have to be real people. All the Assassins Creed games have held true to this."

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15. **The Association For Preservation Technology International, Accessed April 6, 2014. http://www.apti.org/.**

    A website which showcases and documents modern techniques used in the field of historic preservation. Architects, conservators, engineers, contractors, craftspersons, educators, and students publish articles through this resource and serves as an excellent record for both community interest and dissemination.

16. **Ronald Jantz, Michael J. Giarlo. "Microform & Digitization Review." Digital Preservation: Architecture and Technology for Trusted Digital Repositories. no. Issue 3 (2005): Pages 135–147. http://www.degruyter.com/view/j/mfir.2005.34.issue-3/mfir.2005.135/mfir.2005.135.xml (accessed April 6, 2014).**

    This article compares and contrasts traditional preservation practices with those which are more modern and technologically based. Questions such as, "Can we preserve a digital object for at least one hundred years?" are postulated. The article aims to help in building trust in a digital preservation process which can be readily integrated into the current network and framework of the field.

17. **Library of Congress, "A Model Technological and Social Architecture for the Preservation of State Government Digital Information Project." Accessed April 6, 2014. http://www.digitalpreservation.gov/partners/states_mn.html.**

    Documents and disseminates legislative methods pertinent to preservation and access to its digital content relative to the implementation of an information management system and the testing of both its capacity and public adaptation.

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18. **Suzanne Noruschat, . Yale University Library, "Addressing the Challenge of Preserving Born Digital Design Records - See more at: http://mssa.commons.yale.edu/2013/10/28/addressing-the-challenge-of-preserving-born-digital-design-records/**

    As architects and preservationists increasingly abandon paper and choose software to draw their models, these files can be difficult to recover as due to the various formats available with each computer application. This article in the Yale library discusses ways for repositories who collect architectural records to preserve and provide public access to digital materials.

19. **Mark A. Matienzo, . Manuscripts and Archives department of Yale University Library - See more at: http://mssa.commons.yale.edu/2013/09/26/collaboration-before-preservation/**

    A department of the Yale University library which provides a way to access digital records preserved with obsolete media. Floppy disks, compact discs, DVDs, Iomega Zip Discs, are all protected and modernized and arranged with description and documentation for future collections. This specific example notes the importance of collaboration between Yale and other libraries to provide access to these formats of digital media.

20. **Ronald Jantz, Michael J. Giarlo. "Digital Preservation Architecture and Technology for Trusted Digital Repositories." D-Lib Magazine. no. Num 6 (2005). http://www.dlib.org/dlib/june05/jantz/06jantz.html (accessed April 6, 2014).**

    An article which attempts to standardize the field of digital preservation and quell concerns of trust for the digital format. Many definitions are put forth regarding concepts of preservation including documentation, digital objects, liability, and management. The field of digital preservation is specifically defined as, "the managed activities necessary: 1) For the long term maintenance of a byte stream (including metadata) sufficient to reproduce a suitable facsimile of the original document and 2) For the continued accessibility of the document contents through time and changing technology."

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21. **Digital Building Heritage, "An Arts & Humanities Research Council (AHRC) Funded project at De Montfort University: Enabling Community Heritage groups with advanced digital technologies. - See more at: http://digitalbuildingheritage.our.dmu.ac.uk/**

    Provides expertise and consultation in surveying of buildings and structures, 3D modeling, 3D laser scanning of buildings, monuments and artifacts, 3D printing of buildings monuments and artifacts, Computer Animation and real–time Virtual Reality simulation, and mobile application development.

22. **Archaeovision, "Archaeogeomancy: Digital Heritage Specialists." Accessed April 1, 2014. http://www.archaeogeomancy.net/2014/02/archaeovision/.**

    A new company specializing in 3D modeling, imaging, and recording for the web/data management sector of the heritage field. The operation is world–wide and includes surveying and reconstruction of everything from objects and monuments to buildings and landscapes.

23. **SUTD Digital Conservation, "Heritage Buildings and Digital Tectonic." Accessed March 1, 2014. http://ds1.jeneratiff.com/.**

    Asian cultural heritage is much older than many Western institutions. A challenge of digital heritage within this realm involves the domain of undrawable architecture which exists through use of organic material such as timber or masonry that is particularly susceptible to deterioration through various climactic conditions, a polygonal modeling process is documented and demonstrated which is aligned with traditional historic values through a philosophical understanding of techniques used at a specific time and place.

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24. **Havenga, Michelle, Kyle Williams, and Suleman Hussein. "Motivating Users to Build Heritage Collections Using Games on Social Networks." The Outreach of Digital Libraries: A Globalized Resource Network. (2012): 279-288. http://link.springer.com/chapter/10.1007/978-3-642-34752-8_34 (accessed February 23, 2014).**

    A publication which acknowledges the unsuccessful attempts of the past at motivating public participation and contribution to heritage collections. A new approach proposed by the authors of this publication uses Facebook to promote awareness and dissemination of cultural information. The idea aimed to motivate people to submit content to their digital library by exploiting the ways that people interact on social media to provide user generated content that is advertised by the very people who submit to the collection, through their Facebook pages.

25. **Stephen, Fai, Graham Katie, Duckworth Todd, Wood Nevil, and Attar Ramtin. "BUILDING INFORMATION MODELLING AND HERITAGE DOCUMENTATION ." . http://www.autodeskresearch.com/pdf/Fai.pdf (accessed February 15, 2014).**

    An example of three separate projects which vary in scale and complexity, showing how the documentation and conservation of architectural heritage are managed from design to implementation of each particular project. Various workflows are discussed which emphasize both visual fidelity and accurate data. The authors conclude by inferring that Building–Information–Modeling is still in need of a web based resource which standardizes and disseminates the materials and methods of heritage documentation to promote the continued operation and development of heritage sites as they continue to age and be managed, which may lead to many versions and iterations of models as they continue through their lifecycle.

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26. **Stylianidis, Efstratios, Petros Patias, and Mario Santana Quintero. The ICOMOS & ISPRS Committee for Documentation of Cultural Heritage, "CIPA HERITAGE DOCUMENTATION BEST PRACTICES AND APPLICATIONS." Last modified 2007 & 2009. Accessed April 1, 2014. http://cipa.icomos.org/fileadmin/template/doc/RELATED LITERATURE/CIPA_Series_1__2007-9.pdf.**

    Documents the survey of the interior of two churches, the Magdalene in Pesaro and San Dominic in Arezzo, both in Italy. Systems are integrated which define the level of detail for various models and breaks down the project into three separate iterations, the periods of Reconnaissance, Preliminary, and Detailed. Each project provides a good example of going through iterations of each project in phases which increase in accuracy and detail relative to both time and budget.

27. **Joel Burgess, . Gamasutra: The Art & Business of Making Games, "Skyrim's Modular Approach to Level Design." Last modified 05 01, 2013. Accessed January 25, 2014. http://www.gamasutra.com/blogs/Joel-Burgess/20130501/191514/Skyrims_Modular_Approach_to_Level_Design.php.**

    A presentation which demonstrates production methodologies used by the company Bethesda to create game levels and models as efficiently as possible. The concept of modular design breaks models and assets down to simple systems which can be reconfigured effectively and cohesively to provide a high bang–for–your–buck process.

28. **Carlin, Dan. "Show 40 - (BLITZ) Radical Thoughts."Hardcore History. Dan Carlin October 12 2011. Web, http://www.dancarlin.com/disp.php/hharchive.**

    Dan Carlin cites examples from the 20th century in order to express ways in which the pressures of living through events as they happen generate fear. Emotions can cloud judgment , this phenomena is examined by discussing how the consequences of fear can generate potentially dangerous ideas in society.

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29. **Epic Games, Inc, "Unreal Engine 4." Accessed March 26, 2014. https://www.unrealengine.com/.**

    The official online community for Unreal Engine developers. This invaluable resource will serve as technical documentation for the use of the Engine for interactivity and visual fidelity. Additionally, it will provide a method of communication with Epic employees to troubleshoot any technical issues that may arise as a result of the scope of the project.

30. **4 Bentham, Jeremy. The Panopticon Writings. Ed. Miran Bozovic (London: Verso, 1995). p. 29-95**

    The utilitarian principles of Bentham were influential on John Haviland, the architect behind the hub-and-spoke design of Eastern State Penitentiary. It is important to understand the influences of the men behind the construction of Eastern State in order to contextualize their methods and decisions. It is from Bentham that Haviland envisioned the central rotunda from which one prison guard could view every cell block and consequentially every cell from one single vantage point in the prison.

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Ronald Jantz, Michael J. Giarlo. "Digital Preservation Architecture and Technology for Trusted Digital Repositories." D-Lib Magazine. Num 6 (2005). http://www.dlib.org/dlib/june05/jantz/06jantz.html (accessed April 6, 2014).